Ocean Sci. Discuss., 10, C711–C715, 2013
www.ocean-sci-discuss.net/10/C711/2013/

Ocean Science
Discussions
Open Access

Interactive comment on "Temporal variations of zooplankton biomass in the Ligurian Sea inferred from long time series of ADCP data" *by* R. Bozzano et al.

R. Bozzano et al.

roberto.bozzano@cnr.it

Received and published: 16 December 2013

We would like to thank the reviewer for carefully reading the paper and his/her appreciation for the overall content of the work.

We agree with general comments and we will improve the paper by providing a short discussion about advantages and limitations of the method. Among the advantages, we will further underline the applicability of experiment in other areas especially in remote locations in any weather conditions and not contaminated by suspended sediments. Of course, in-situ measurements could significantly improve the description of the zooplankton temporal variation in the water column by providing sea-truth samples

of the populations.

For our experience, the ideal experimental set-up should consist of a high spatial (in terms of bin size) and temporal resolution deploying an ADCP below the layer interested by the zooplankton activity (e.g., 0-300 m). However, technical constraints (bin size depending on the ADCP frequency, battery duration, etc.) usually limit the possibility to perform such kind of experiment for a long period. As suggested, another more feasible configuration could be the use of two ADCP instruments deployed, for example, at 150 m depth, one upward and the other downward.

As mentioned in the paper, the time series used for the proposed analysis were not specifically acquired to monitor the zooplankton migration, but to study the upper layer current variability and for this reason the study covers only the period 2003-2006. After February 2006 the mooring line hosting the ADCP was removed.

Section 3 is related to the analysis of zooplankton behavior and its variability using raw backscatter data, spectral analysis of the acoustic time series and vertical velocity measured by the ADCP. All these information were used to analyze changes in the zooplankton population. Hence, title of section 3.5 will be modified omitting "changes in the zooplankton population".

Below, we provide detailed replies point-by-point to the specific comments.

- A figure of the investigated area will be added to the final paper.

- Page 1371, Line 11-20. Seasonal and spatial variations of the zooplankton population in the area have been referred to the study performed by Licandro et al., 2000. The requested information can be viewed in figure 6/page 2237 that shows the average monthly density of some zooplankton species.

- Page 1371, Lines 28-28, Page 1372, Lines 1-5. By taking into account also the comment of Referee 2 the paragraphs will be reformulated.

- Page 1372, Lines 13-17. The sentence will be rewritten by stating that strong vertical

stratification prevents vertical mixing reducing oxygen contribution from atmosphere to the deep layers of the ocean.

- Page 1372, Line 28. The physical characteristics of the water masses the authors refer to, are sea water temperature, salinity and density.

- Page 1373, Line 15-21. No measurements are available to authors after February 2006. - Page 1374, Line 1. For all three deployments, the mooring line hosting the ADCP consisted of the same parts and it was nominally positioned at the same location. Nonetheless, considering the bottom depth (about 1300 m) of the deployment and irregular morphology, the ADCP depth changed along the water columns. The temporal resolution increased during the third deployment since the recovery of the mooring was initially planned on Autumn 2005, although it was recovered only in February 2006.

- Page 1374, Line 14. The analysis was performed using all available data for the three deployments. Only the analysis of distribution of the horizontal current velocity, shown in Figure 1, was obtained using data from October to February, which is the period common to all deployments.

- Page 1375, Line 16. The doubled word “formula” has been cancelled.

- Page 1377, Line 21. Figure 3 has been modified: monthly average time-series were detrended to emphasize the variations, uncertainties in the estimation of the monthly average values were added as error bars, and time axis of all subplots were aligned. Monthly minima and maxima time-series were aligned and provided as separate subplots.

- Page 1378, Lines 8-13. The text describes Figure 3 and 4 in paragraph 3.1 separately from Figure 5 (paragraph 3.2). We prefer to keep them separate.

- Page 1378, Lines 14-18. Unfortunately, the authors do not have access to any CPR data. Thus, although we agree that it could be meaningful to add field data to modeled data shown in Figure 4, it is not possible to add such kind of data to the plot.

- Page 1379, Lines 20-25. These observations fully agree with estimates of zooplankton vertical velocity, which indicate higher values during ascent (ca. 5-8 cm s-1), i.e. at sunset when zooplankton migrate toward the surface, and lower during descent (3-4 cm s-1), i.e. at sunrise (Smith, P.E., Ohman, M.D. and Eber, L.E. (1989). Analysis of the patterns of distribution of zooplankton aggregation from an acoustic doppler current profiler, CalCOFI Report, 30, 88-103.).

- Page 1379, Lines 26-29. A short discussion regarding why vertical velocities observed at dusk and dawn may be attributable to zooplankton has been inserted at the end of Section 3.4.

- Page 1380, Lines 1-11. Since we don’t have in-situ reference measurements, we can only make some assumptions based on the knowledge of zooplankton groups present in the investigated area and supported by our analysis. Specifically, spectral analysis evidences the presence of two separate migrating patterns at 12h and 24h that can be ascribed to different species: for example, Meganycthiphanes norvegica shows a prominent 24h cycle but, depending on the moon phase, it also migrates every 12h. The same also for Thysanoessa spp., whereas pteropods such as Cavolinia inflexa usually have only a 24h cycle. The backscatter intensity of the DVM may also varies depending on zooplankton age and sex, hence it is possible to correlate the overall spectral patterns to the evolution of different stage of life. We add this discussion to the end of paragraph 3.4.

- Page 1380, Line 15. The authors agree that equal y-axis in Figure 8 might be the standard visualization mode, but this should imply only the visualization of a blank portion in the subplots of rows 1 and 3 and in our opinion this will make the plots less clear for the reader.

- Page 1380, Lines 16-25. Based on the knowledge of the authors, no other similar measurements are available in the basin during the rest of 2003. 2003 was one of the hottest years at sea, at least in the near surface layers, and noteworthy phenomena

occurred all over the Mediterranean Sea. Hence, we do not feel to make any assumption.

- Page 1381, Lines 1-28. We do not think that the significant 12h migration pattern shown in the third deployment is an artifact of the spectral analysis due to the 30 min temporal resolution sampling since it appears well evident also in the other 2 deployments when the temporal sampling was different (1h). Indeed, the thicker temporal resolution (30 min instead of 1 h) allows a better detection of relatively fast zooplankton migration having a semidiurnal cycle.

Interactive comment on Ocean Sci. Discuss., 10, 1367, 2013.